

CONTROL ID: 1797259

TITLE: Terrestrial Analogs for Clay Minerals at Yellowknife Bay, Gale Crater, Mars

AUTHORS (FIRST NAME, LAST NAME): Allan H Treiman¹, Richard V Morris², Thomas Bristow³, Douglas W Ming², Cherie Achilles^{2, 4}, David L Bish⁴, David Blake³, David Vaniman⁵, Steve Chipera⁶, MSL Science Team⁷

INSTITUTIONS (ALL): 1. Lunar & Planetary Inst, Houston, TX, United States.
2. ARES Division, NASA Johnson Space Center, Houston, TX, United States.
3. NASA Ames Research Center, Moffett Field, CA, United States.
4. Department of Geological Sciences, University of Indiana, Bloomington, IN, United States.
5. Planetary Science Institute, Tucson, AZ, United States.
6. Chesapeake Energy, Oklahoma City, OK, United States.
7. Jet Propulsion Laboratory, Pasadena, CA, United States.

ABSTRACT BODY: Sediments of the Sheepbed unit, Gale Crater, were analyzed by the CheMin X-ray diffraction instrument on the Curiosity Rover. The sediments consist of typical basalt minerals (Fe-forsterite, augite, pigeonite, plagioclase), as well as Fe oxide/hydroxides, Fe-sulfides, amorphous material, and a phyllosilicate. The phyllosilicate has a broad 001 peak at ~1.0 nm, consistent with a poorly ordered smectite. However, in the absence of diagnostic tests possible on Earth, its identity is not clear. The position of the 06L diffraction band is generally used to distinguish dioctahedral from trioctahedral smectite, but it is beyond CheMin's range of 2 θ . The measured position of the 02L diffraction band (~22.5° 2 θ by CheMin), implies that the smectite is trioctahedral. The exact position and shape of the 02L band is determined by the cations in the 'M' sites of the smectite; to constrain those cations, we sought analogs among terrestrial smectites, emphasizing those developed from basaltic precursors.

A potential analog for the Sheepbed smectite is 'griffithite,' a variety of trioctahedral smectite in altered basalt of the Topanga formation, Griffith Park, Los Angeles. 'Griffithite' has an 02L diffraction band that is close in position and shape to that of the Sheepbed smectite, although 'griffithite' has a very sharp 001 peak, indicating a high degree of layer ordering not seen in the Sheepbed smectite. A typical chemical formula for 'griffithite,' determined by electron microprobe, is (Ca_{0.59} Na_{0.03}) (Mg_{4.28} Fe_{1.83}) (Si_{6.64} Al_{1.36}) O₂₀ (OH)₄, normalized to Si+Al=8. This formula is consistent with a fully trioctahedral Fe-Mg smectite with Ca and Na as interlayer cations. In the Topanga basalt, four types of 'griffithite' are present: fine-grained, filling cracks and vesicles; coarse-grained, filling vesicles; coarse-grained, replacing olivine phenocrysts; and coarse-grained, replacing glassy mesostasis. The fine-grained 'griffithite' formed first, and the last three varieties may be contemporaneous. One sample shows agate (α -quartz) that was precipitated between the episodes of deposition of the fine-grained and coarse-grained 'griffithite.'

'Griffithite' is not unique as a possible terrestrial analog – some clay minerals from the Doushantou formation, China, have similar 02L diffraction bands, and many basalts contain smectites in vesicles and as replacements after olivine. Similar trioctahedral smectites occur also in the nakhlite martian meteorites – as veinlets and replacements of olivine. By understanding the formation of these terrestrial clays, we hope to constrain the nature and mechanism of formation of the Sheepbed clay mineral.

KEYWORDS: 5470 PLANETARY SCIENCES: SOLID SURFACE PLANETS Surface

materials and properties.

(No Image Selected)

(No Table Selected)

Additional Details

Previously Presented Material: 0 %

Contact Details

CONTACT (NAME ONLY): Allan Treiman

CONTACT (E-MAIL ONLY): treiman@lpi.usra.edu

TITLE OF TEAM: The MSL Science Team
